

# ***Kongsberg FS-400C-R1 Maintenance Manual***

This document contains the hardware description and maintenance information for the FS-400C-R1.

## Document history

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# 1 HARDWARE DESCRIPTION

This section describes the FS-400C-R1 hardware configuration.

## 1.1 Cabinet layout

The FS-400C-R1 cabinet has 12 dedicated positions for Remote I/O (RIO) modules. See Figure 1 for the locations.

The Remote Controller Units (RCU) A and B are located at the top of the rear wall of the cabinet. Network connections for RCU A and B are located on the left side wall.

The power supplies and magnetic circuit breakers (MCBs) are located in the lower part of the left wall. The net filters are located above the MCBs .

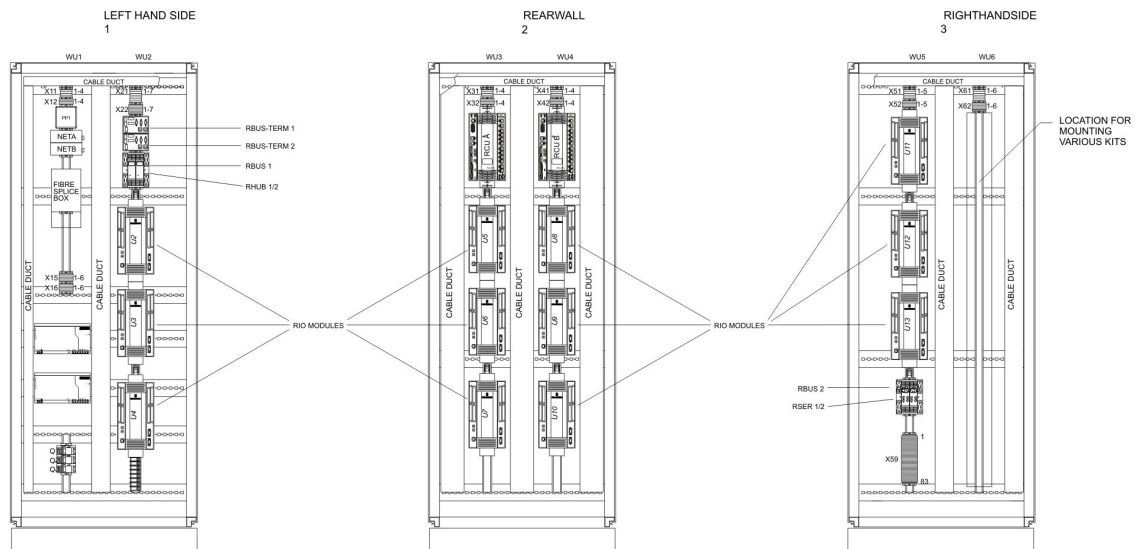
The serial line termination board, BUS-Term, is located at the upper left wall.

The two BUS-Term modules, Term 1 for RBUS 1, and Term 2 for RBUS 2, are located at the top of the left wall.

Hub 1 for RBUS 1, and Hub 2 for RBUS 2 are located below Term 2. These hubs are optional.

The RIO-modules are located at the left, rear and right walls of the cabinet.

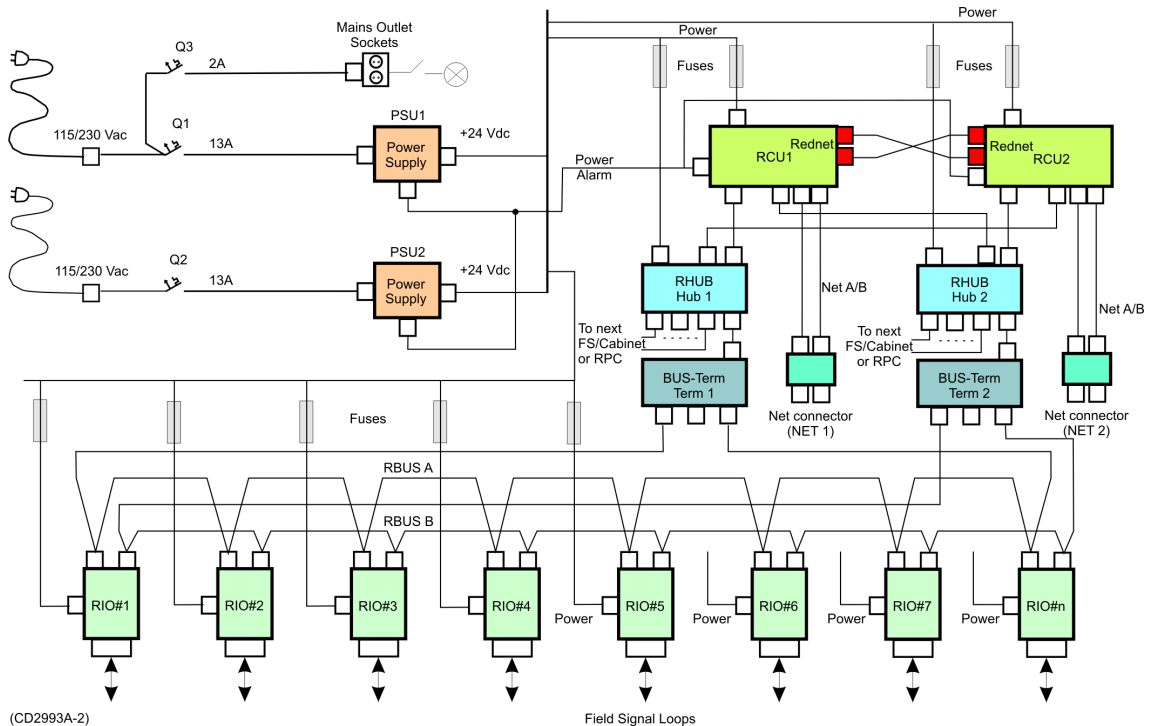
Figure 1 Layout of FS-400C-R1 cabinet



## 1.2 Block diagram

The block diagram of FS-400C-R1 is given in Figure 2.

Figure 2 Block diagram of FS-400C-R1



## 1.3 Power supply

FS-400C-R1 can use either 230Vac or 115Vac as mains supply. It is delivered with a dual 230Vac/115Vac power supply unit (PSU).

The block diagram in Figure 2 shows the power supply diagram of FS-400C-R1.

Mains power is connected through an MCB to the input of the AC/DC power supply. The MCB trips and opens the circuit if the current exceeds the rated MCB current.

The power supply provides 24 Vdc for the RCU and RIO modules, and for the RBUS (serial process bus).

There are diodes inside the PSU, connected in series with the power supply outputs. These are provided for interconnecting the two power supplies, this:

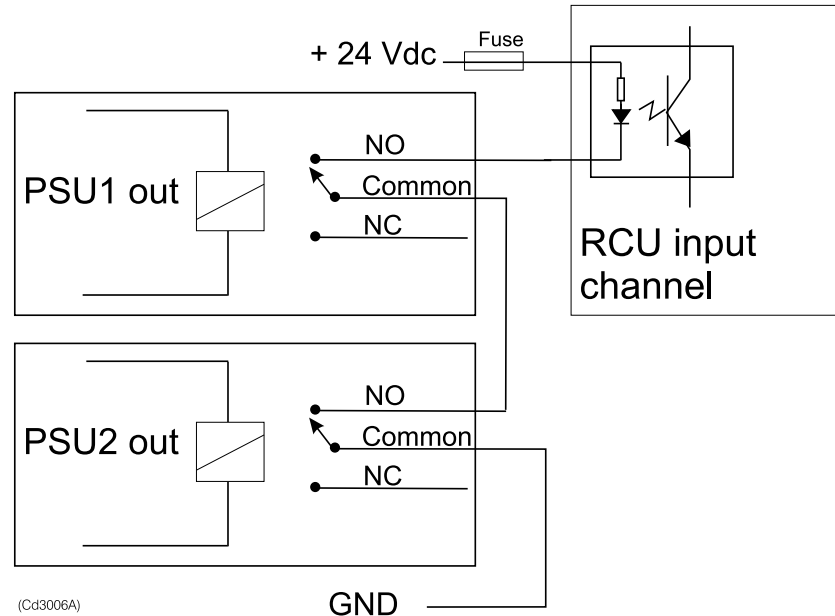
- Enables independent monitoring of the power supply outputs through the relay contacts.
- Prevents an error in one power supply output from interfering with the output of the other.

### 1.3.1 Power supply output monitoring

Built-in relay outputs are used for sensing the output voltage from the power supplies. If the correct voltage is sensed at the outputs, the relay contact remains closed.

To occupy only one I/O input channel, the two relay contact sets are connected in series. See Figure 3. To sense which of the two power supplies has failed, RIO input channels are used, one for each PSU. The power supply that shows a loss of voltage is the faulty power supply.

Figure 3 Dual power alarm detection



## 1.4 RCU master/slave connection

The two RCUs are connected to each other using a set of handshake signals. These signals synchronize the two RCUs and exchange status information to enable fast, bumpless switching if the master controller fails.

## 1.5 Remote I/O modules (RIO modules)

Any combination of RIO modules can be used in the FS-400C-R1. See the vessel's documentation for details of the RIO modules that are used in a specific field station (FS).

### 1.5.1 Power for RIO modules

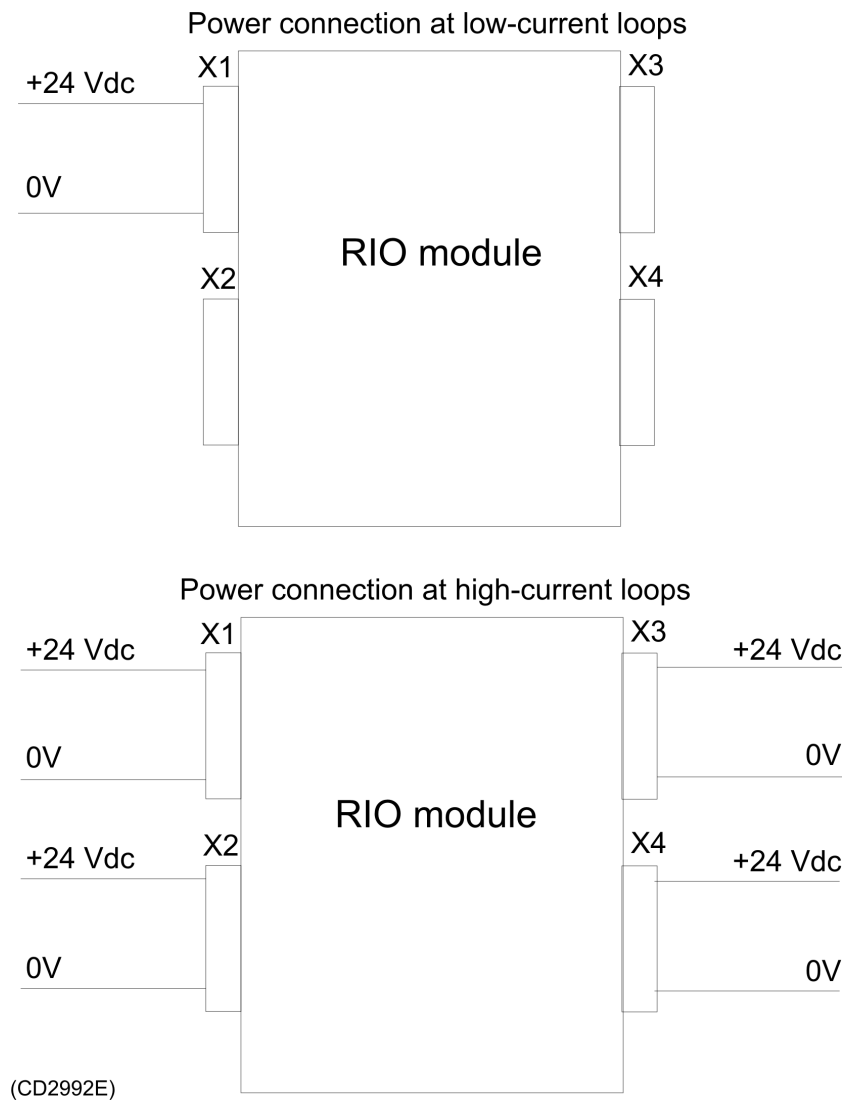
There is usually no need for connecting more than one pair of 24 Vdc and 0V terminals from the RIO to the power supply. However, digital outputs from high side drivers can deliver a loop current up to 1A. If a RIO module uses several high-current output loops, more pairs of power terminals must then be connected to the power supply. See Figure 4.

**Note**

*The rule of thumb is that if a high current channel in a terminal block of the RIO module is used, the two power terminals of that terminal block should be connected to the power supply.*

See the applicable hardware module description for more details.

*Figure 4 Power connection at low and high loop currents*



**1.5.2 Grounding RIO modules**

The RIO modules are usually not grounded.

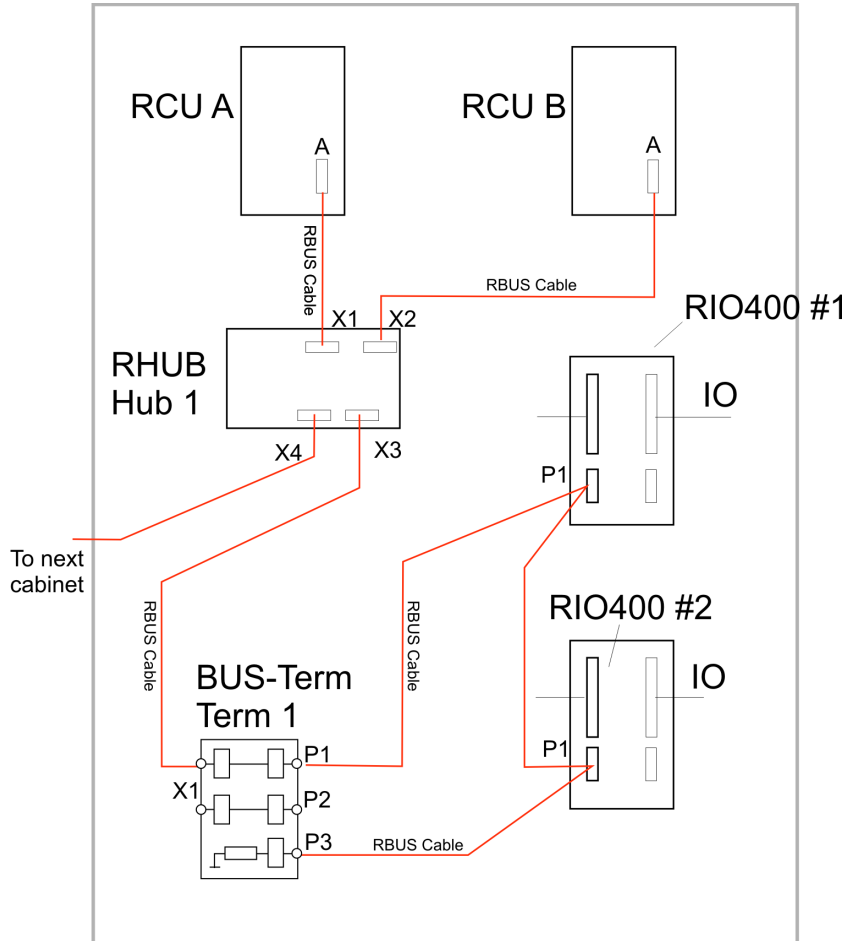
For more details on the grounding principles, refer to the hardware module description for the RIO module.



## 1.6 Serial Process Bus (RBUS)

Figure 5 shows the internal cabling layout of the Serial Process Bus (RBUS) in the FS-400C-R1, for one RCU.

Figure 5 Serial Process Bus in FS-400C-R1



(CD3013)

RCU A is connected to Hub 1 by an RBUS cable. Hub 1 splits the RBUS channel into five physically separate bus channels. One of the RBUS channels is connected to the BUS-Term termination board. The hub is mounted to the cabinet on two horizontal rails.

The RIO modules are connected to the BUS-Term in a daisy chain. One end of the daisy chain is connected to connector P1 and the other end to connector P3. The RBUS is terminated at connector P3. See Figure 5.

### 1.6.1 RBUS Power

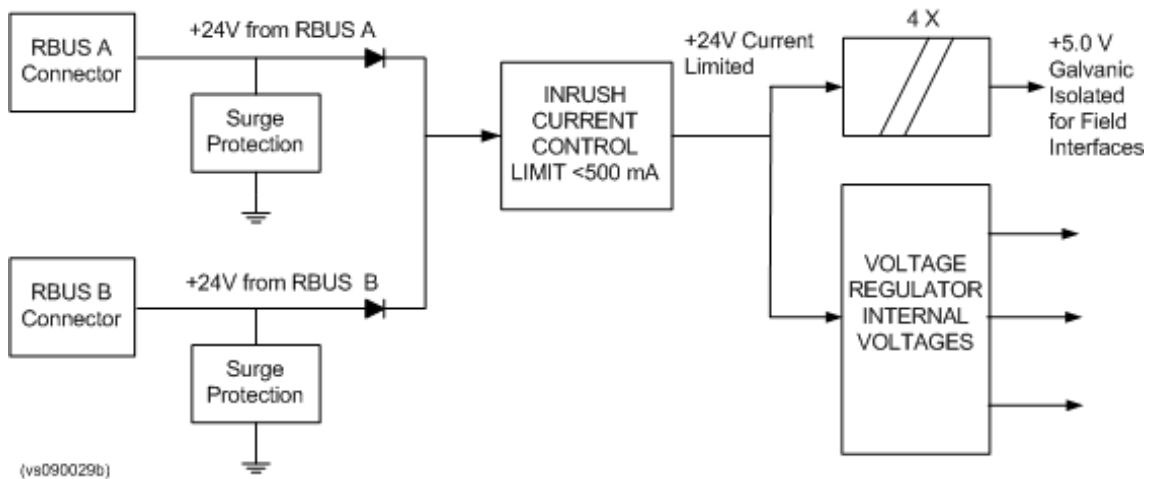
The local 24 Vdc power supply provides power for the RBUS, through the terminal block X1 in the BUS-Term card. For details of the power supply terminals, refer to the hardware module description of the BUS-Term.

## 1.7 Serial line interface RSER

The RSER200-4 module provides the I/O interface, network hub/repeater and serial line interface. The RSER200-4 is a five channel, galvanically isolated, serial line interface module. It can be connected to one, two or three RCU modules. Each of the four field channels can be configured as either RS232, RS422, RS485 or NMEA 0183, as necessary for connecting field equipment. There are three Link Channel interfaces for connection to the controllers. The RSER200-4 is powered by the RBUS connectors. The RSER200-4 has a Run/error LED, which indicates the module status. Other LEDs indicate the transmit and receive data activity for each channel. The RSER200-4 module can be hot replaced during operation.

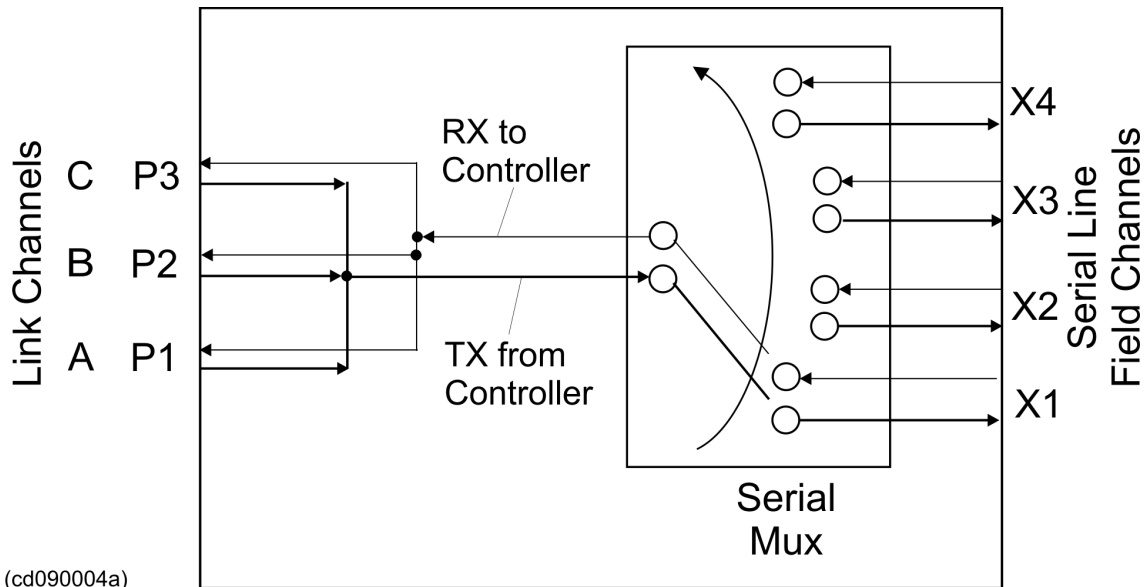
The RSER200-4 can be powered by either single or dual 24Vdc voltage from the RBUSA and RBUSB connectors. See Figure 6.

Figure 6 Power block diagram for the RSER200-4



An RCU can send serial data through one RSER200-4 to four serial line field channels. This is enabled by a serial multiplexer in the RSER200-4 module. See Figure 7.

Figure 7 Serial line switching in RSER



(cd090004a)

## 1.8 Field Cabling

### 1.8.1 Field cable termination

The outer shields field cables are cut and terminated inside the through-holes, in the bottom plate of the cabinet. The signal wires are strapped to the back wall cable supports and connected to the termination blocks on the RIO modules.

### 1.8.2 Spare cores

How and where the spare cores are terminated, can differ between vessels. Normally, spare cores must be terminated to either the PE or IE bar.

## 1.9 Technical specifications

Table 1 FS-400C-R1 technical specifications

<b>POWER SUPPLY REQUIREMENTS</b>	
The FS-400 C-R1 can work normally with one power supply, if the other power supply unit fails.	
Voltage	115/230 Vac
Typical power consumption	560 W
Maximum power consumption	1100 W
<b>MECHANICAL SPECIFICATION</b>	
Size: width x height x depth	806 x 2202 x 805 mm

*Table 1 FS-400C-R1 technical specifications (cont'd.)*

Weight	270 kg
<b>ENVIRONMENTAL REQUIREMENTS</b>	
EMC	Non-shielded cabinet
IP degree	IP54
Typical heat dissipation	230 W
Maximum heat dissipation	440 W
Noise level	< 40 dB
Also refer to Kongsberg Maritime Environmental Specification, reg. no.: 161011	

## 2 FAULT FINDING

This section tells you how to find faults in the FS-400C-R1.

### 2.1 General fault finding and repair

The flowchart given in Figure 8 tells you how to troubleshoot the FS-400C-R1. A combination of the following information items listed below may also be required to locate errors and correct the system:

- Status information or alarm messages shown in the application window on the operator station. See the applicable Operator Manual for more details on this topic.
- Status LEDs and lamps on hardware modules such as the power supplies and RIO modules. See the applicable hardware module description for details.
- Values of power-output voltages, and the status of fuses in the system. See the applicable hardware module description for more information.
- System-specific diagrams, lists and drawings. See the applicable drawing file for details.
- Replacement procedures for replaceable modules. See the corrective maintenance section or the applicable hardware module description for details.

If you are not able to correct the error situation yourself, you should contact your nearest Kongsberg Maritime service office for advice or to request service on board.

### 2.2 Reading power status LEDs and measuring supply voltages

The PSU 1 and PSU 2 are AC/DC converters that convert 230 Vac or 115 Vac to 24 Vdc. The status of the PSU 1 and PSU 2, for the 230 Vac version is shown by a DC OK LED on the front of the power module. If the DC power output is OK, the DC OK LED remains green in colour. The green DC OK LED flashes if there is overvoltage or overcurrent at the input, or if there is a short circuit.

The power modules are located in the left inside wall of the cabinet. Their output voltages can be measured on the power terminals.

You can measure the mains voltage using a multimeter with AC-range. If the supply voltage is 24 Vdc, you must use a multimeter with DC range.

## 2.3 Equipment status

The RIO modules run built-in test programs that continuously check for faults when the system operates. System messages and alarms related to the field station are shown in the operator station and/or event/alarm printer to inform the operator about process station faults and alarms. They also bring any other applicable information to the operator's attention. Refer to the applicable operator manual for detailed information about the equipment status. Refer to Figure 8 for a general fault finding flowchart when system messages/alarms are given.

## 2.4 Fault finding table

The table below gives system symptoms that can be observed from the operator stations, the causes of the symptoms and recommended corrective actions.

Table 2

ID	SYMPTOMS	PROBABLE CAUSE	CORRECTIVE ACTION
<b>1</b>	<b>Dual power supplies, dual LAN, dual RBUS</b>		
1.1	One RCU module in this FS-400C-R1 has lost contact with the system. Local LED is red.	Defective RCU module.	If there are recurring errors in the RCU: <ol style="list-style-type: none"> <li>1. Check the event log and take notes of the events</li> <li>2. Reset the RCU</li> <li>3. If the errors recur, replace the RCU module.</li> </ol>
1.2	One RIO module in this FS-400C-R1 has lost contact with both RCUs. Local LED is red.	Defective RIO module.	If there are recurring errors in the RIO: <ol style="list-style-type: none"> <li>1. Check the event log and take notes of the events</li> <li>2. Reset the RCU</li> <li>3. If the errors recur, replace the RCU module.</li> </ol>
1.3	One RIO module in this FS-400C-R1 has lost contact with one RCU. Local LED is red.	Defective RIO module. RBUS cable continuity is broken. Lost connection on RBUS for this RCU.	Replace the RIO module. Replace the RBUS cable. Reset the RIO module.

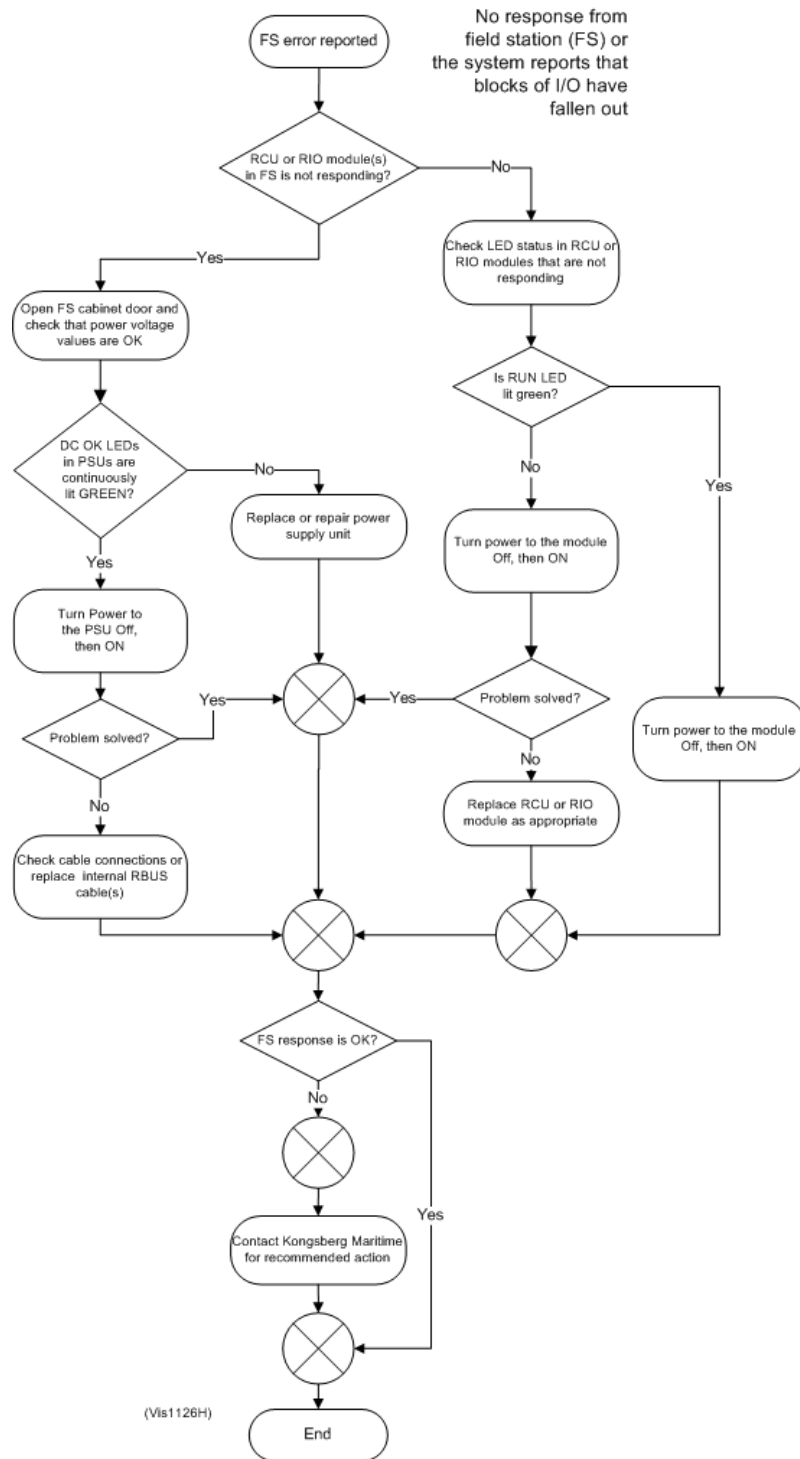
Table 2 (cont'd.)

1.4	A LED in X11, X21, X31, X41 is not lit although the corresponding fuse has blown.	Defective LED in the field termination block.	Replace the LED termination block.
1.5	Power error reported for this FS-400C-R1.	<p>One or both PSUs have failed.</p> <p>One of the two power connections to this FS-400C-R1 is lost.</p> <p>MCB Q1 or Q2 is tripped.</p> <p>PSU1 or PSU2 output voltage is cut off due to overload.</p> <p>An alarm relay output on PSU is defective.</p>	<p>Make sure that both DC OK LEDs in the PSUs are continuously green. If the DC OK LED is flashing, there is an error in the DC output voltage. Check for overcurrent or overvoltage in the input power to the PSU. Also check for short circuits in the input and output. Make sure that the output voltage is the same in both PSUs. Refer to the power supply data sheet for instructions on how to set the output voltage.</p> <p>Make sure the 115/230 Vac supply voltage is available.</p> <p>Close Q1 or Q2 as applicable.</p> <p>Restart the PSU1 or PSU2 power supply as applicable.</p> <p>Replace PSU1 or PSU2 as applicable.</p>
1.6	No I/O signals from field Profibus cabinet.		<ol style="list-style-type: none"> <li>1. Check the event log and take notes of the events.</li> <li>2. Reset the remote cabinet.</li> <li>3. If the errors recur, replace the RCU module.</li> </ol>

## 2.5 Fault finding flowchart

Figure 8 shows a general fault finding flowchart that tells you how to repair the field station after lost blocks with I/O occurs.

Figure 8 Field station fault finding flowchart





### 3 PREVENTIVE MAINTENANCE

This section gives the preventive maintenance procedures for the FS-400C-R1.

#### 3.1 How to tighten screws in the termination blocks

Use an insulated screwdriver with a 2 or 3 mm wide bit, as applicable, and tighten any loose screws.

#### 3.2 How to check connector locks

Use a screwdriver to tighten locking screws on the D-SUB and other types of cable connectors.

Check if the RJ45 network connector plugs are locked by pushing them into the connector. If the connector is not locked in position, you will hear a click as it locks.

Flat cable connector locks should be checked by visual inspection only. Make sure that the locks are in the correct position.

#### 3.3 How to clean cabinets/equipment housing

Use a lint-free, non-abrasive cloth and a neutral or mild soap solution for best result. Do not use a dripping wet cloth when cleaning. Only use a moistened cloth for cleaning.

#### 3.4 Preventive maintenance intervals for FS-400C-R1

Note \_\_\_\_\_

*The maintenance intervals vary depending on the installation site, an assessment should be undertaken to determine the best preventive maintenance intervals for the specific installation.*

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Table 3 Recommended maintenance intervals for FS-400C-R1

Action	Interval recommended
Tighten screws in the termination blocks	Every six months
Check connector locks	Once a year
Clean cabinets/equipment housing	Once a month

## 4 CORRECTIVE MAINTENANCE

This section gives the corrective maintenance procedures for the FS-400C-R1.

Corrective maintenance procedures that are not described in this section are given in the applicable hardware module descriptions. All the parts listed in the replaceable parts and recommended spare parts list usually have a hardware module description. Corrective maintenance of parts that do not have the procedures described, should only be done by Kongsberg Maritime service personnel.

### 4.1 Replacing PSU1 or PSU2

This procedure gives the steps you must do to replace a defective power supply, either PSU1, PSU2 or both, in FS-400C-R1.

Note

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*To replace the power supply module, you must be authorised to turn off the power to the FS-400C-R1 cabinet that contains the power supply. You must also have a spare power supply.*

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#### **WARNING**

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***Electrical hazard. Switch off all the power lines to the field station before you replace the power supply. Tag out the applicable switches or circuit breakers, to stop the power from being accidentally switched on while you work. Failure to heed this warning can lead to electrocution, serious injury and death. You should ask your safety representative for information on how to tag out electrical switches and circuit breakers.***

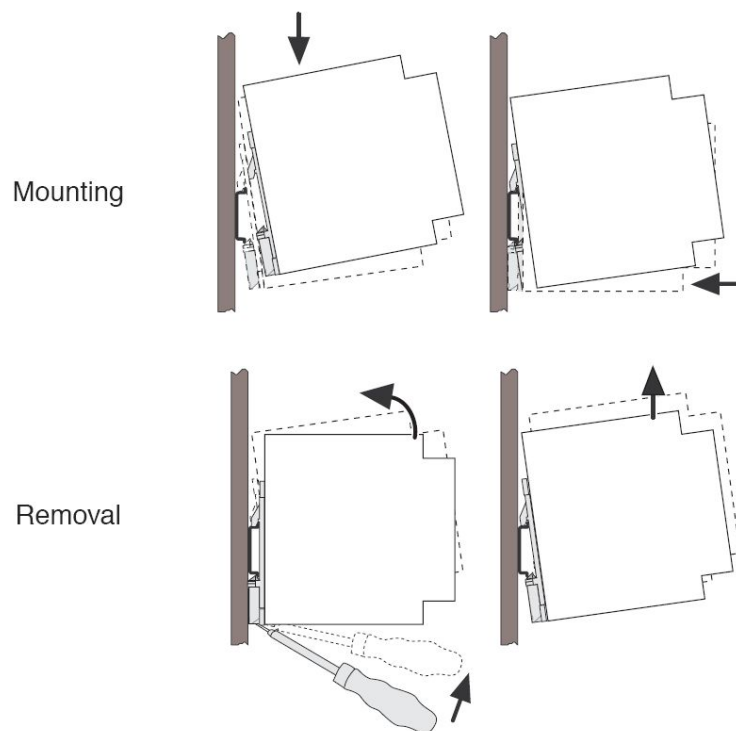
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- 1 Open the front door of the FS-400C-R1.
- 2 Set the circuit breakers Q1 and Q2 to the OFF position.
- 3 Disconnect the wires attached to the PSU using a flat-bit screwdriver.
- 4 Remove the faulty PSU:
  - Release the snap-on catch using a screwdriver.
  - Detach the module from the bottom edge of the DIN rail.See Figure 9.
- 5 Attach the new PSU in the correct position:
  - Place the power supply with the DIN rail guideway on the top edge of the DIN rail.
  - Push the bottom end of the power supply onto the DIN rail till it locks.

See Figure 9.

- 6 Attach the wires to the PSU using a flat-bit screwdriver
- 7 Switch ON the power lines to the FS-400C-R1 cabinet.
- 8 Set the circuit breakers Q1 and Q2 to the ON position.
- 9 Make sure that the RUN LED in the RCU module becomes green after a while.
- 10 Make sure that the RUN LED in the RIO modules become green after a while.
- 11 Make sure that the RCU and RIO modules are working correctly by viewing the operator station status.
- 12 Close the front door of the FS-400C-R1 cabinet.

*Figure 9 Mounting and removing the power supply unit*



## 4.2 Replacing the Q1, Q2 or Q3 circuit-breaker

This procedure gives the steps that you should do to replace defective miniature circuit breakers (MCB), Q1, Q2 and Q3.

Note

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*To replace the MCB, you must be authorised to switch off power to the FS-400C-R1 cabinet that contains the MCB. You must also have a spare MCB.*

---

**WARNING**

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***Electrical hazard. Switch off all the power lines to the field station before you replace the MCB. Tag out the applicable switches or circuit breakers, to stop the power from being accidentally switched on while you work. Failure to heed this warning can lead to electrocution, serious injury and death. You should ask your safety representative for information on how to tag out electrical switches and circuit breakers.***

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- 1 Open the front door of the FS-400C-R1.
- 2 For your safety, switch off all the circuit breakers in the cabinet.
- 3 Use a flat-bit screwdriver to remove the wires attached to the faulty MCB.
- 4 Remove the faulty MCB.
- 5 Attach the new MCB.
- 6 Attach the wires to the MCB using the flat-bit screwdriver.
- 7 Switch ON the power lines to the FS-400C-R1.
- 8 Switch ON the circuit breakers in the cabinet.
- 9 Make sure that the RUN/Error LED in the RCU module becomes green after a while.
- 10 Make sure that the RUN/Error LED in the RIO modules become green after a while.
- 11 Make sure that the RCU and RIO modules are working correctly by viewing the status of the operator station.
- 12 Close the front door of the FS-400C-R1 cabinet.

### 4.3 Replacing the RIO module

This procedure gives the steps that you should do to replace defective RIO modules.

Note

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*To replace the RIO module, you must be authorised to switch off power to the FS-400C-R1 cabinet that contains the RIO module. You must also have a spare RIO module.*

---

**WARNING**

---

***Electrical hazard. Switch off all the power lines to the field station before you replace the RIO module. Tag out the applicable switches or circuit breakers, to stop the power from being accidentally switched on while you work. Failure to heed this warning can lead to electrocution, serious injury and death. You should ask your safety representative for more information on how to tag out electrical switches and circuit breakers.***

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- 1 Set MCB Q1, Q2 and Q3 to the OFF position.
- 2 Replace the defective RIO module using the instructions given in the RIO hardware module description.
- 3 Set MCB Q1, Q2 and Q3 to the ON position.

**4.4 Replacing the RCU or the fan in the RCU module**

- 1 Set MCB Q1, Q2 and Q3 to the OFF position.
- 2 Replace the defective unit using the instructions given in the RCUXXX hardware module description.
- 3 Set MCB Q1, Q2 and Q3 to the ON position.

**4.5 Replacing the BUS-Term module**

- 1 Set MCB Q1, Q2 and Q3 to the OFF position.
- 2 Replace the defective unit using the instructions given in the BUS-Term hardware module description.
- 3 Set MCB Q1, Q2 and Q3 to the ON position.

**4.6 Replacing RHUB module**

- 1 Set MCB Q1, Q2 and Q3 to the OFF position.
- 2 Replace the defective unit using the instructions given in the RHUB hardware module description.
- 3 Set MCB Q1, Q2 and Q3 to the ON position.

## 5 REPLACEABLE PARTS AND CONSUMABLES

This section contains lists of replaceable parts, recommended spare parts and consumables used in FS-400C-R1. Replacement procedures for the listed parts are described in the appropriate Hardware Module Description. No replacement procedures are supplied for the consumables.

### 5.1 Replaceable parts and recommended spare parts

Table 4 *Replaceable parts and recommended spare parts*

List ident.	Part name	Recommended as spare part	Part number
1	Power Supply QUINT-PS-100-240AC/24DC/40		316930
2	FUSE AUTO 2P0LE E92S C02 AEG		324121
3	FUSE AUTO 2P0LE E92S B13 AEG		324353
5	BUS-Term		310955
6	RHUB		603442
7	Terminal Block WSI 4 LD		317521
8	RCU501	x	603439
9	RIO-units as applicable	x	see the applicable hardware module descriptions

### 5.2 Consumables

Table 5 *Consumables*

List ident.	Part name	Where used	Part number
1	Fuse, 5x20 mm, 6.3 A AF	X21: F5-F7 X31: F2-F4 X41: F2-F4 X51: F1-F3	43522218

Table 5 Consumables (cont'd.)

2	Fuse, 5x20 mm, 4 A AF	X11: F1-F4 X21: F1-F4 X51: F4-F5 X61: F1-F6	43505858
3	Fuse, 5x20 mm, 2 A AF	X31: F1 X41: F1	43505833

## 6 HW CONFIGURATION STATUS

(This information is for Kongsberg Maritime use only)

The configuration status of documents describing the FS-400C-R1 hardware for this revision of the Maintenance Manual are listed below:

- Parts Lists

BOM FS-400, Field Station RBUS: 323443

- Drawings

General Arrangement, FS-400: 305954, Rev. C

Cabinet Layout, FS-400 RBUS: 323445, Rev. A

Power and Wiring Diagram, FS-400  
RBUS: 323448, Rev. A

Wiring Diagram, FS-400 RBUS: 323449, Rev. A





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